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AMERICAN JOURNAL of PHARMACY

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A Record of the Progress of Pharmacy and the Allied Sciences

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THE AMERICAN
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VOL. 98 AUGUST, 1926 NO. 8

EDITORIAL

"THE DAY OF INVENTION DRAWS TO ITS CLOSE"

ALTHOUGH this statement is quoted by the press as an Edisonian aphorism, it is very doubtful that it was ever uttered by the great inventor. Perhaps the phrase itself bespeaks inventive genius in a cub reporter.

Yet it is not unlikely that Edison may have predicted a lull in the business of inventing. The past decade or two have brought us so many unbelievably comforting devices that there must come a compensating period lean in such productiveness.

The material comforts now enjoyed by civilized races may drone us into mental desuetude exactly as in pharmacy—the arts of the miller—of the pill and plaster and tablet maker—of the tincture and elixir factory—have conveniently lulled the apothecary into a sweet state of unconcern and professional apathy. The once oft-used mortar is a mere motto and the rest of his instruments are idle ornaments.

But who is there living today would change, were it possible, his pleasant earthly tenancy, for a time in the past, when pulse-warmers and antimacassers were luxuries?

It is not a far cry to the day in England when the first crude locomotive puffed and clattered over groaning rails past quiet Yorkshire hamlets—and gaping, gasping natives turned their eyes to heaven for comfort—for they thought certainly that this was the end of things.

Could they but have the current privilege of speeding over velvet roads in cushioned horseless carriages, or of breezing over tree-tops in a canvas tub—or of picking operas out of clouds and perfectly dry lectures between the raindrops—or of wearing lustrous garments, chemist-carpentered out of pine, yet silkier and smoother than ever a

silkworm could spin—or of having a slice of anatomical landscape carved off with hardly any suffering (this may not qualify as a privilege, exactly)—or of enjoying the thousand blessings which have become to us commonplace and thrill-less—we wonder what their reaction would be.

Nor need we feel that there is but little yet to learn and less to do. Man has ever been spasmodically acquisitive—and while it may be very true that earth shall never again witness a period so replete with useful innovations and so compressed with material progress as the past quarter century—there is actually so *little* achieved and so *much more* in the offing that it were far more correct to predict that the day of invention is only at dawning.

Could we but stand on the pinnacle of a century hence, looking backward, what marvels of human accomplishment would be ours to see.

Will the atom have yielded its secret by then, and will locomotion, heat and light production and power of all kinds be drawn from atomic sources? Perhaps!

Will the scientist have solved the many problems now engaging his attention?

Synthetic food (synthetic drinks have been long since available) will have become a reality. Harnessing sunlight for heat and light may have been accomplished. Prediction is already made that night may soon be made light as day—with the day's own lantern—science having now learned the secret of sunlight absorption and re-emission.

The next war in the Balkans or elsewhere—with all its brutalities, and all its thunder—may have been seen and heard on a radio-screen in the parlor—and stay-at-homes will have more reason than ever to vote for universal peace.

Even the secret of life may be solved, although the most ambitious and hopeful doubt that this can ever be done.

. . . . .

It is a great day in which we live and there are great promises for tomorrow. The world has never been a more comfortable rendezvous for its self-improving parasites. Only—our single hope is that when Edison's lull in *material* progress eventuates, inventors out of work can find much to do in directing the course of earth to a much-needed *spiritual* recrudescence.

IVOR GRIFFITH.

HAY FEVER RESEARCH IN COLORADO

TO ONE who like the present writer has no appreciable reaction to any plant or animal tissue in dust form, it is difficult to understand how some may suffer therefrom. It is, however, only too evident that a considerable proportion of human beings have such susceptibilities. They are but little understood even after much research. It is customary for scientists to conceal their ignorance by refuge to the Greek, and hence we hear of "idiosyncrasy," "allergy," "anaphylaxis" and such.

Pollen has been clearly connected with the common forms of hay fever, and much has already been accomplished in the employment of vaccines for the relief of the disease. A recently published report of the State Historical and Natural History Society of Colorado, sets forth the work of its Hay Fever Committee, of which Dr. James J. Waring was the director, with the active co-operation of Miss Mary Alice Pope, Assistant Curator of State Museum at Denver. Colorado is the home of a number of plants producing the disease. Some of these are also well known in the eastern section of this country, such as ragweed and grasses. Two unfamiliar plants are especially noted: *Kochia scoparia,* known as "summer cypress," and *Salsola pestifer,* known as "Russian thistle." These are members of the Chenopodiaceæ. Several species of ragweed, not known in the East; also species of sage brush are found. The report, which is a pamphlet of seventy-five pages, numerously illustrated with figures of plants and pollen, contains elaborate details of the distribution of the offending and non-offending species. Information is also given as to the seasonal incidence of pollination, the relative abundance of pollen and the methods by which it is usually carried. It is customary to classify pollens by their method of dissemination, distinguishing them as anemophilous (wind-borne), and entomophilous (insect-borne). Wind-borne pollens are dusty and produced, as a rule, in flowers that are inconspicuous and not nectar-bearing, but circumstances may modify very much the method of distribution of a given pollen. This has been well shown by the observations of Professor George Potts of Bloemfontein, South Africa. The pollen of the so-called "pepper-tree," which is really a sumac (*Schinus molle* L.) is ordinarily carried by insects, but the climate of Bloemfontein is very dry and windy, and the pollen of the tree is carried about as dust. Potts found positive evidence of its causal relation to hay fever. It has been recently stated that in some parts of California where the tree is familiar, the dryness of the climate gives rise to wind distribution of the pollen with consequent

infection. It is not the form, size or source of pollen that causes trouble, but the method of distribution. Ragweed pollen is not large and is heavily spiculated; corn pollen is very large and smooth. These both cause disease. Pollen of the common (ox-eye) daisy is small and spiculated; that of the common mallows, Althea and Hollyhock, is large and much spiculated, but neither is regarded as infecting.

It is noted in the report that the pollen of certain goldenrods found in Colorado is not infecting, but this is not invariable, for some persons are promptly irritated when in contact with certain species of *Solidago*. Of course, in all cases the pollen is but one part of the action; the special susceptibility of individual is the other part. This susceptibility may be indicated by the use of terms from the Greek, but such is no explanation.

HENRY LEFFMANN.

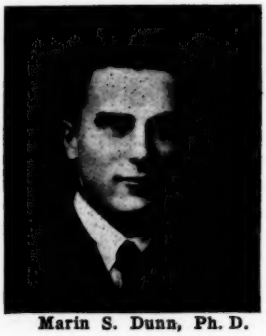
ORIGINAL ARTICLES

ABNORMAL PLANT GROWTHS (GALLS)*

By Marin S. Dunn, Ph. D.

Assistant Professor of Botany, Philadelphia College of Pharmacy and Science

GALLS are abnormal growths produced in plants by plant and animal parasites. They have been known to man for centuries and many curious theories have in the past been advanced concerning their origin. Malpighi in the seventeenth century is said to have been the first observer to discover that galls develop from plant parts pierced by insects, and he thought that the insects inject a substance into plant tissue that causes a swelling. There are thousands of different kinds of galls (Fig. 1), all presenting their own fascinating problems. One does not have to be a trained scientist to note with interest these plant swellings as they are numerous through our woods, along our streams and in our meadows and fields. Many of them are striking because of their shape, size, and color and texture. Some



Marin S. Dunn, Ph. D.

*One of a Series of Popular Science Lectures given at the Philadelphia College of Pharmacy and Science, 1925-1926 Season.

are so easily breakable that they may be crumpled between the fingers, while others are only penetrated by the sharpest knife. They may range from smooth surfaces to wrinkled or hairy ones, or may be covered with spines. The colors vary—green, brown, red, yellow, etc. Yet in spite of their abundance, there is relatively little known concerning them. It is the purpose of this article to touch briefly upon some of the interesting phases of the gall problem.

Fig. 1

SOME GALLS FOUND ON OAK LEAVES

(From Field Book of Insects.—**Lutz.**)

Andricus piger (Fig. 1), under side of midrib; *Cynips prinoides* (Fig. 2), shiny, single celled, under side of leaf; *Cynips pisum* (Fig. 3), surface finely netted, two cavities; *Acraspis erinacei* (Fig. 4), spines red when young; *Dryophanta polita* (Fig. 5), sometimes grows singly; *Neuroterus floccosus* (Fig. 6), with white hairs, under side of leaf; *N. umbilicatus* (Fig. 7)), small nipple in deep, central depression, under side of leaf; *Cincticornia pilulæ* (Fig. 8), upper side of leaf; *Cecidomyia pœulum* (Fig. 9), pale red to light lavender, under side of leaf; *Cecidomyia niveipila* (Fig. 12), fold lined with white pubescence. *Cynips decidua* makes galls about the size of wheat-grains on the under side of midrib, often 30 on a leaf.

The gall, no matter what its shape may be is in reality a modification structurally of some tissue or organs of the host owing to another organism. The abnormal growth is commonly produced either through the enlargement of the already existing cells of the infected tissue (hypertrophy), or by the formation of new cells (hyperplasy), or both (Fig. 2). It is important to note that "often

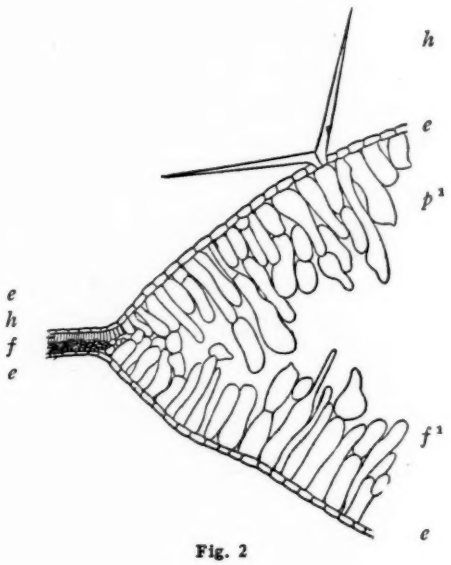


Fig. 2

A cross-section through the edge of a leaf gall of *Viburnum Lantana*, showing striking hyperplasy and hypertrophy; *p*, the palisade cells of the uninfected portion; p^1, the corresponding cells of the infected portion; *f*, the sponge cells of the uninfected portion; f^1, the corresponding cells of the infected portion; *e*, epidermis; *h*, epidermal hair; considerably magnified.—From KÜSTER.

gall tissues remain in a condition more primitive than that of uninfected tissues, the primordia of wood and bast, for example, often remain parenchymatous instead of developing into complex tissues." [4]

Generally, food materials are stored in the galls, in nutritive layers, and this supply may later be used by the parasite for growth. Sometimes these nutritive layers are very definitely formed as in the case of members of a certain group of insects (Cynipidæ), in which the larval chamber may be surrounded by an inner protein and an outer carbohydrate layer (Fig. 3). In the same type of galls, interest-

ing mechanical tissue is often developed around the food-storing areas. Tannins and resins are very common among galls.

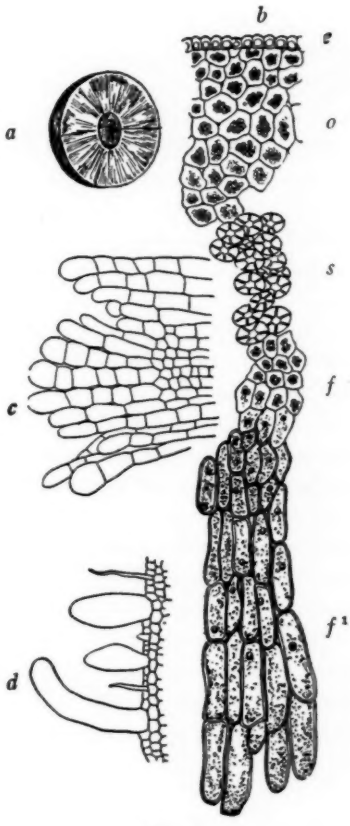


Fig. 3

Cross-sections of galls, showing anatomical features: *a*, a solid cynipid gall from an oak twig, cut in half; note the radiating lines of tissue, and the central larval chamber; *b*, a section of an oak gall; *e*, epidermis; *o*, cortex, the grains representing plastids (choloroplasts above and leucoplasts with prominent starch grains below); *s*, protective layer of sclerenchymatous cells; *f*, f^1, nutritive layers adjoining the larval chamber, *f* being a layer rich in start, and f^1 a layer whose cells are rich in proteins and prominently nucleated; *c*, part of the nutritive tissue of the gall of *Nematus gallorum;* note the resemblance to the tissues in an intumescense; *d*, isolated nutritive hairs of a Cephaloneon gall from a maple (*Acer*); *b. d.*, highly magnified.—*a*, after KERNER; *b*, after LOCAZE-DUTHIERS; *c*, *d*, after KÜSTER.

Since galls may be due to either plant or animal parasites, it has been thought advisable to discuss briefly the subject according to the following outline:

Animals Producing Galls.
- Class Nematoda.
- Class Insecta.
  - Order Hemiptera—the aphids, etc.
  - Order Lepidoptera—moths and butterflies.
  - Order Coleoptera—bettles.
  - Order Diptera—flies.
  - Order Hymenoptera—sawflies, gallflies.
- Class Arachnida.
  - Order Acarina—mites and ticks.

Plants Producing Galls.
- Sub-Division Fungi.
  - Class Myxomycetes—the slime molds.
  - Class Schizomycetes—the bacteria.
  - Class Phycomycetes—the water molds.
  - Class Ascomycetes—the ascus fungi.
  - Class Basidiomycetes—the smuts, rusts, etc.

Various algæ such as *Cystoseira sp.* and *Ectocarpus Valiantei* are known to live a parasitic existence and cause tissue excrescences. Higher parasites such as certain *Loranthaceaæ* produce large galls.[8] It is not the intention of this paper to do more than mention them in passing.

Animals Producing Galls

Class Nematoda

Nematodes are round worms. There is an alimentary canal with a mouth opening at the anterior end and an anal opening near the opposite end on the under side. To this class belong the Anguillula or Eel-worms, which are destructive to various plants. They are minute, thin-skinned and look like miniature eels. The larvæ suck the juices from young roots and bore into them, eventually producing galls. The following is taken from Connold [2] to illustrate the group: "Kühn's investigations have supplied many details concerning the species *Heterodera schachtii,* which affects the beetroot. The ♀

may be found attached to the rootlets of the beet. At a certain stage of growth she becomes distended into the shape of a lemon, which causes her death. The skin is then a mere sac, which may contain as many as 400 ova. The larvæ emerge from the majority of these within the sac, but, owing to the pressure from within, it ultimately ruptures, and the larvæ are liberated; they at once commence to attack the rootlets around them, and cause the formation of gall-growths."

But nematode galls are not confined to roots alone. *Tylenchus dipsaci* Kühn has been studied by Godfrey and McKay [7] on the wild strawberry. They find that swellings occur on leaves, stolons and flower pedicels and even in the flowers and fruits.

Class Insecta

There are thousands of different galls produced by insects—remarkable in their endless variety of appearance and structure. Generally, the eggs of the insects are laid in some characteristic part of the plant and the insect spends some of its life within the plant, the larvæ feeding upon the plant cells or their contents.

Hemiptera.—The galls produced by certain Hemiptera, for example the aphids or plant lice, are characterized according to Cosens [3] by a folding and wrinkling of the leaf when they appear upon it. This is occasioned by a one-sided stimulation. There is not much tendency to produce hairs, and the tissues of the galls show as a rule but little differentiation. Among the host plants are *Populus balsamifera L.*, *Hamamelis virginiana* L., *Betula lenta* L., and *Picea abies* (L.) Karst.

Lepidoptera.—The galls are of simple type, showing as a rule proliferation in the tissues, but very little differentiation. The provision made by the larva to allow the moth to leave the gall is in many cases most interesting. To quote from the excellent work of Cosens: [3] "In *Stagmatophora ceanothiella* Cosens and *Eucosma scudderiana* Clemens the gall wall is simply gnawn partly through, while in the Gnorimoschema genus an aperture of exit is carefully prepared and plugged. These different methods of procedure are remarkably suited to the habits of the insects. In the former a plugged exit would not be suitable as the insect winters in the larval condition and the drying of the gall would prevent the plug from slipping out easily. In the latter the galls are still green when the insect becomes mature, and the plug mechanism is preferable."

Coleoptera.—There is fine field here for investigation, as our knowledge of coleopterous galls is not far advanced. The Weevil family, according to Connold,[2] embraces almost all the gall-makers. The galls are not very large, it is said. Eggs are deposited not only in the roots but in the stem, flower-heads, etc., as well.

Diptera.—The galls here vary greatly in degree of complexity. Some like *Cecidomyia ocellaris* O. S. are simple, others are as complex as certain Cynipids galls. In some cases, abundant production of glands is evident. In *Cecidomyia triticoides* O. S. there is a zone whose cells contain crystals of calcium oxalate. The formation of aeriferous tissue is noteworthy. Among the hosts of this group are *Impatiens biflora* Walt., *Eupatorium perfoliatum* L., *Salix cordata* Muhl., *Solidago canadensis* L., etc.

Hymenoptera.—Among the sawflies, there is not much differentiation although a large amount of proliferation is found. The pith of the bundle is said to produce almost the whole mass of the gall when its place of origin is the midrib of the leaf. Cosens has found lenticels on the galls of *Pontania pisum* Walsh. Tannin in certain species is found in the epidermis and underlying tissue, but decreases as the larva is neared. In the *Cynipidæ,* or gallflies, there are usually four zones developed (Fig. 3), but occasionally the fourth is absent. The three are the epidermal, the parenchyma and the nutritive. A protective or sclerenchyma zone is generally present. There may even be a great variation in the degree of complexity of this protective zone with a genus. In *Rhodites gracilis* Ashm. it is absent, but two layers are said to be present in *R. ignotus* O. S.

Many cynipoid galls are found upon the oak. One or more larvæ may develop within the gall depending upon its kind. "The full development of none of the American gall-making Cynipoids has been studied with the care which this subject should have and doubtless there are many interesting and important facts yet to be discovered." (Howard.)[9] We know that there are guest gallflies which look like the true gallflies, their larvæ living upon the plant growth groduced by the true gallflies. Each gallfly infects its own particular kind and part of a host plant, and the galls produced by a species upon a plant are so uniform that very often the causative insect may be deduced from the appearance of the gall.

Order Acarina

Here belong the mites and ticks—minute arachnids having eight legs. The stimulative effect here may either be localized in the epidermis or extend throughout the mesophyll of the leaf. There is a curving and folding of the epidermal layer and often the production of various hairs. The mesophyll in case it be affected becomes a compact mass of uniform cells—palisade and spongy parenchyma no longer being distinguishable. Some of the host plants are *Prunus serotina* Ehrh., *Prunus nigra* Ait., *Populus tremuloides* Michx., *Acer negundo* L., *Fagus grandifolia* Ehrh. and *Quercus macrocarpa* Michx.

Plants Producing Galls

It has been thought suitable to describe briefly a typical gall belonging to each class of gall-making fungi as an example of that class. It must be remembered of course that fungi are devoid of chlorophyll and that many pass through complicated life histories.

Class Schizomycetes

Example: Crown Gall of Apple, Peach, etc.

This is caused on various *Rosaceæ* by *Pseudomonas tumefaciens* Erw. Smith and Townsend.

The organism is a short rod moving by means of one to three lash-like structures-flagella. The galls differ on different hosts only slightly in form and appearance. They develop in the region of the collar of the host, near the surface of the soil as a rule (Fig. 4). The gall is generally an annual growth. The swollen areas are at first translucent, but later become brown and warty. Near the end of the season, disintegration takes place. "Young galls may, however, spring from the collar or roots near the margin of the gall previously formed, and thus the wounds and injurious effects are intensified from year to year." (Duggar.)[5] Death of parts of the plants above the infected area gradually occurs owing to the effects of the bacteria upon the conducting tissue of the host.

Class Myxomycetes

Example: Club Root of Cabbage and other crucifers.

This is caused by a slime mold, *Plasmodiophora brassicæ* Wor. This is the famous fingers and toes of Europe. In the United States, the Northeastern States have felt its effect. Seedling host

plants are small and gradually die. The parasite gains entrance to the parenchyma of the roots and there sets up abnormal growth, which results in the characteristic nodular swellings or masses of knotty areas to the irregular finger-like swellings in the cabbage. Among the hosts, we find the cabbage, the cauliflower, the turnip, the rutabaga, etc. A complete outline of the life history as we know it, would be out of place here. A true plasmodial stage is apparently found just preceding spore formation. For a fuller account of the history of this organism, the reader is referred to Duggar,[5] Harshberger.[8] It has been found that liming is useful in preventing this disease.

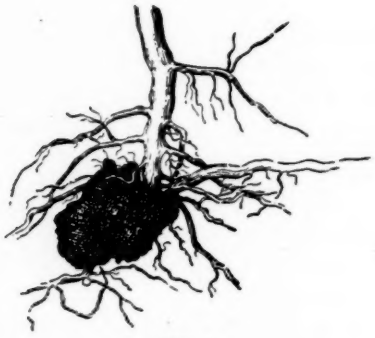


Fig. 4

CROWN GALL OF PEACH

(From Fungous Diseases of Plants.—**Duggar.**)

Class Phycomycetes

Example: Cranberry Gall.

Small reddish galls are produced upon various infected parts of the cranberry plant in numbers by *Synchytrium Vaccinii* Thomas. The body of the fungus is a cell which produces later a great number of swarm spores which are dependent upon moisture for their distribution.

Class Ascomycetes

Example: Witches' Broom of the Cherry; Black Knot of Plums and Cherries.

The mycelium or fungus body of *Exoascus Cerasi* Fuckel attacks the branches of the *Prunus avium* and *Pr. Cerasus* in Europe, caus-

ing by its stimulation the formation of a great number of twigs giving the appearance of a broom. The leaves also show the results of fungal infection as they become wrinkled. Asci develop upon the leaves. The brooms are usually sterile.

Another common Ascomycete gall is the black knot of plums and cherries (Fig. 5), which is caused by *Plowrightia morbosa*. It is known to extend across the northern portion of United States. The

Fig. 5

BLACK KNOT OF PLUM (After Longyear)

(From Fugous Diseases of Plants.—**Duggar.**)

disease, as the name indicates, is characterized by knotty black hypertrophies which form usually on one side of the stem or branch. Let me quote from Duggar:[5] "The first appearance of the knot is usually noted in the spring, although it has also been observed to make its appearance in the fall (Humphrey). At first it consists of a slight swelling of the branch, originating upon any portion whatever, but generally on that portion of a limb bearing a side branch. It may arise independently, or near an old knot. As the swelling increases in size the bark is broken and the stroma of the fungus then becomes

evident. By midsummer the knot will have attained full size, and from that time until the winter, or as long as the remnants of the knot may persist, it will be deep black and carbonaceous in texture." The knot is composed of areas of fungus and a heterogeneous mixture of tissue elements of the host.

Class Basidiomycetes

Example: Cedar Apples.

Cedar apples are swellings produced on the leaves of the red cedar by *Gymnosporangium juniperi-virginianæ*. This fungus has two hosts. Part of its life history (the cluster cup period) is spent on our native species of apples. Spores are produced in large numbers on the apple during the summer, and the red cedar is infected by them. The following spring, the cedar apple is developed from the parenchyma of the red cedar leaf. Other spores that are produced by the cedar apple about May are indirectly responsible for the infection of the apple. Unhappily, the damage done by this fungus is to the apple fruit and leaves and not the red cedar. The destruction of red cedar trees has been advanced as a feasible method of prevention of this disease.

It thus appears in general that gall formations are not an advantage to the host plant since food and energy are required for their construction. Also, of course, the parasite may introduce harmful substances into the part of the host it infects and may produce ill-health or even death, local or general. The removal of food materials from the host is another factor that must be recognized since partial or complete starvation may result. However, in the case of certain root tubercles, the galls may be of great advantage to the host in relation to a nitrogen supply.

Man, of course, is directly affected by the infection of his economic and ornamental plants. The problem brought to us by such forms as have briefly been mentioned (Crown Gall, Club Root, etc.) is a direct one. It requires a diligent search and thorough study of all those parasites related to our economic happiness.

On the other hand, certain galls have been found of benefit to man. Some contain a large amount of tannin and are hence of commercial value. The Nutgall formed upon the young twigs of *Quercus infectoria* Olivier and other allied species of Quercus is official in the U. S. P. X.[14] The following description is taken from the U. S.

P. X of the unground Nutgall—"Nearly globular, from 0.8 to 2.5 cm. in diameter, heavy, mostly sinking in water; externally dark olive-green to dark grayish, tuberculated on upper portion; basal portion smooth and contracted into a short stalk; fracture short, horny; internally grayish to dark brown, with a central slightly radiate portion; occasionally with a central cavity connected by a narrow, radial canal to the external surface; odor slight; taste strongly and persistently astringent." Before the insect matures, the galls are collected. One of the principal sources is from Aleppo in Turkey in Asia.

Fig. 6

ROOT SYSTEM OF PEA PLANT, WITH TUBERCLES

(From **Palladin's** Plant Physiology.)

Other galls have also been employed. Chinese galls used by the Chinese in dyeing and in medicine for instance are yielded by *Rhus semialata* Murray, and they have been found to possess a high percentage of tannic acid. Since they contain less coloring matter than the oak gall used, they are of value in the manufacturing of gallic acid.

They are more or less irregular in shape, being greyish-brown, hairy and light in weight. Certain American galls might here be mentioned. For example, the galls on the *Quercus coccinea* Muench and *Quercus imbricaria* Michx. by *Cynips aciculata* resemble the Aleppo variety. When fresh, they are globular 1.5 to 3 cm. in diameter and of a yellowish mottled color.

Another group of galls that are of service to man are the nodules of leguminous plants (Fig. 6). Hellriegel and Wilfarth, as a result of a series of careful experiments found that the root tubercles are directly instrumental in the assimilation of the nitrogen of the air by leguminous plants. The nodule bacteria in the case of the legume enter into the root hairs, and finally find their way into the parenchyma of the root. Cell division of the parenchyma occurs at the same time, which results in a swelling and in the formation of a tubercle. The bacteria, which were at first surrounded by a sheath enter the cell sap, where they grow and branch becoming bacterioids. These finally yield soluble nitrogenous substances to the host plant through the breaking down of their bodies. Thus leguminous crops ploughed under enrich the soil by their decay and furnish nitrogenous material to the crop of the following season.

The problem of galls as a form of abnormal plant growth is a vast one and offers unlimited field for experimentation. Dr. Erwin F. Smith has investigated tumor-like growths known as Crown Gall, extensively. In one paper upon the subject,[13] he says: "No claim is made that the organisms which we have isolated, and with which we can produce these plant tumors at will, are the cause of human cancer. On the other hand, evidence is advanced that they induce a set of phenomena which, allowing for the differences between the higher plants and animals, follow a strikingly parallel course. No broadly inclusive definition of cancer can be drawn that will not, along with the human and animal neoplasms, include also these plant tumors as true cancers."

The exact nature of the stimulus involved in gall-formation is not known. Some workers maintain that it is a mechanical stimulus; others, a chemical one. Any actively growing tissue has the ability to answer the gall-producing stimulus, it is thought, making use of its power to grow by growing in a definite direction. The mechanical irritation, occasioned by oviposition, will not produce a gall. Take away the egg and the gall will not form.[6] As has been pointed out, the gall-producers' influence may cause decided changes in the affected part of the host, new tissues, glands, hairs, etc., appearing. Cosens,[3]

however, points out that these supposedly new characteristics may simply be dormant and latent characteristics residing in the protoplasm of the host and brought out under the influence of the stimulus. For example, glands were found to be plentiful in the gall produced by *Neolasiostera perfoliata* Felt on *Eupatorium perfoliatum* L., but were not found at the same location in the normal plant. They were finally found at the base of the stem.

Another very important question is the nature of the rôle played by enzymatic action in gall formation. To cite Cosens,[3] "Concerning the nature of this powerful stimulating agent there is at present a growing tendency to ascribe it to enzymatic action." It has been brought out that if the larvæ can change starch into sugar through enzymatic action, then the sugar would not only be available to the larvæ, but also to the gall as well. The cell enlargement and multiplication and also the appearance of vestigial structures may be the response of the protoplasm to a large food supply. The shape of the gall is partly governed by the direction of the stimulus and the location of the egg or eggs.

To summarize briefly, there is much to be done in this largely unknown field for both amateur and expert. Among other things, there are life histories to be made known, gall development to be studied, changes in cell contents to be followed and the production of galls artificially under known and controlled laboratory conditions to be accomplished before we may claim that we have mastered the problem.

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A COMPARISON OF METHODS OF DIGITALIS STANDARDIZATION

By Charles L. Wible

(From the Department of Pharmacology, University and Bellevue Hospital Medical College, New York)

AS WILL be seen from a study of the literature there are numerous methods available for the quantitative determination of the activity of the members of the digitalis series The principal aim in the assaying of a drug or its preparation is, of course, to secure a means of measuring its therapeutic efficiency. Where different methods of assaying are used it is necessary that the results parallel each other, or that there be some direct and constant ratio between the results obtained by the various procedures; otherwise the method fails of its purpose.

One of the objects of the present study was to examine the results of three of the methods of digitalis standardization to see whether they would, in our hands, give approximately uniform figures. Since six of the tinctures assayed were made from *Digitalis lutea* leaves it was also of interest to see whether the methods employed were applicable to the same degree to *Digitalis lutea* preparations as to *Digitalis purpurea* preparations.

Tinctures V and VII were made in our laboratory at least two years ago. Samples I and II were procured from the cardiac ward of Bellevue Hospital. Sample VIII was made from *Digitalis lutea* leaves grown in the drug garden of the College of Pharmacy, University of Nebraska. The remainder of the tinctures were manufactured by a leading pharmaceutical house and had been so standardized by the manufacturer that according to their assay the average lethal dose, injected intravenously into cats, was the same for all the tinctures (65 mgm. = 1 c. u.).

Methods Employed

A.—The official frog method (1). In this assay we used a "Tuberculin Syringe" for the injection of the doses into the frogs. By this method the amount of the preparation injected can be accurately measured to the hundredth of a mil. If one follows the technique recommended by the U. S. P. for the measuring and subsequent injection of the doses it is impossible to obtain accurate results.

Temperature, which is a deciding factor in the susceptibility of the frog heart to digitalis (2) (3), did not vary more than one degree above or below 20° C. during any of our assays. All evaporations were carried out on a water-bath at 65° C. Only in tincture XI did we meet with any difficulty in assaying by the official method. In this case we were obliged to use three times the ordinary number of test animals before obtaining results sufficiently clear cut to allow us to draw conclusions. A recent modification of the one-hour frog method (2) may serve to eliminate such variable factors as were encountered in the assay of this preparation.

B.—The colorimetric method, as described by Knudson and Dresbach (4) using a ouabain solution as a standard. Our picric acid was purified and recrystallized before being used in this assay. New sets of reagents were made up at frequent intervals.

C.—The Hatcher cat method (5). In this assay our method of procedure was briefly as follows: A 1:20 dilution of the tincture was injected into the femoral vein at the constant rate of .5 cc. per minute until the end point was reached. The temperature of the fluid being injected was maintained equal to the body temperature of the animal by a water jacket around the burette. The cats were not allowed food for twenty-four hours previous to the experiment. During the period of injection light ether anæsthesia was maintained.

The same sample of ouabain was used for a standard throughout this study. The fatal dose of this sample was found to be 0.1 mgm. per kilogram of cat.

The following table gives the figures obtained by the three methods of analysis used. In the cat and the colorimetric methods the activity per cent. is calculated on a basis of 100 mgm. per cat unit. In the frog method the minimal fatal dose of ouabain was determined for each batch of frogs used and the digitalis per cent. activity obtained according to the U. S. P. calculations.

Table I

Sample	Cat		Colorimetric		Frog (U. S. P.)
	mgm. per c.u.	Activity per cent.	mgm. per c.u.	Activity per cent.	Activity per cent.
D. purpurea					
I	84	119	72.0	138	96
III	100	100	71.5	139	120
V	190	52	107.0	93	30
VII	130	176	64.0	156	170
IX	53.0	188	33.5	298	supply exhausted
XI	53.0	188	38.0	263	240
XIII	72.0	138	35.3	283	150
XV	84.0	119	52.0	192	109
II	64.0	156	supply exhausted		150
D. lutea					
IV	82.0	121	52.0	192	144
VI	89.0	112	41.0	243	105
VIII*	85.0	117	49.6	201	100
X	60.0	166	43.6	229	187
XII	92.0	108	37.0	270	120
XIV	57.2	175	40.0	250	150

*Through the kindness of Doctor Gold, this tincture was assayed one month later in Doctor Hatcher's laboratory and showed an activity of .83 33 = 1 c.u. Five months after Doctor Gold's assay we obtained a figure of .84 = 1 c.u. These figures do not indicate any deterioration in this sample over a period of six months.

It will be noted from Table I that there is agreement within twenty-five per cent. or less in thirteen of the fourteen tinctures assayed by the biological methods. A comparison of the figures derived from our colorimetric assay with those of either of the biological procedures reveals a discrepancy greater than forty-five per cent. in more than half of the tinctures assayed. This discrepancy is always in the same direction, since the results by the colorimetric method show greater activity for each sample than those of the biological methods. This suggests that there may exist a constant ratio between the results of the colorimetric and the biological methods. That this is not the case is shown by an examination of Table II.

In Table II is given the relative activity of the tinctures by the three methods, calculated from Table I. For the purpose of comparison the figures obtained by the cat method are taken as a standard, expressed as 1, and the figures obtained by the other methods calculated in relation to this.

Table II

Sample	*A* *Cat*	*B* *Colorimetric*	*C* *Difference*	*D* *Frog*	*E* *Difference*
D. purpurea					
I	1	1.16	+.16	0.81	—.19
III	1	1.39	+.39	1.20	+.20
V	1	1.76	+.76	0.57	—.43
VII	1	2.05	+1.05	0.96	—.04
IX	1	1.58	+.58	...	...
XI	1	1.39	+.39	1.28	+.28
XIII	1	2.05	+1.05	1.08	+.08
XV	1	1.61	+.61	0.90	—.10
II	1	...	...	0.97	—.03
D. lutea					
IV	1	1.58	+.58	1.09	+.09
VI	1	2.16	+1.16	0.93	—.07
VIII	1	1.71	+.71	0.85	—.15
X	1	1.97	+.97	1.12	+.12
XII	1	1.25	+.25	1.11	+.11
XIV	1	1.42	+.42	0.85	—.15

Column "C" of Table II representing the difference in relative activity of each sample by the cat and the colorimetric methods shows variations ranging from +0.16 to +1.16. The maximal variation is seven times that of the minimal. There is, therefore, no constant ratio between the two methods.

Column "E" representing the difference in relative activity of each preparation by the cat and the frog methods shows with the exception of samples V and XI, a variation ranging from —0.19 to +0.20. This variation being almost equal in either direction is well within the limits of biological error. It is worthy of note that sample V was an unusually weak tincture, while XI was unusually strong.

Samples of tinctures VIII, XIV, VI and IX were sent to Doctor Knudson for colorimetric analysis. Doctor Knudson* reported the following:

Sample	VIII	29.0 mgm.	= 1 c. u.
"	XIV	33.5 "	= 1 c. u.
"	VI	35.0 "	= 1 c. u.
"	IX	29.8 "	= 1 c. u.

With the exception of sample VIII in which there is a wide and unaccountable variation, it will be noted that there is agreement between our figures and Doctor Knudson's in so far as relative activity of the four samples is concerned. This agrees with the findings of other investigations (2). Unfortunately this does not clear up our difficulties since Doctor Knudson's results indicate even greater activity for these preparations than do our assays and, therefore, greater deviation from the results of our biological assays.

In assaying this series of tinctures we have seen only one cat in which respiratory failure came before cardiac failure. We are, therefore, inclined to agree with Hatcher that the end point with the cat method is cardiac failure.

Summary

The cat and official frog methods for the assay of digitalis agree within the limits of biological error.

Judging from the limited number of preparations available for this study the biological methods employed are applicable with the same degree of accuracy to *Digitalis lutea* as to *Digitalis purpurea* tinctures.

The colorimetric method, in our hands, does not parallel the biological methods used. Although our figures obtained by the colorimetric method indicate greater activity for each preparation than do our biological assay they do not establish a constant radio between the results of the colorimetric and biological methods.

The assay of ten commercial tinctures of supposedly uniform strength (65 mgm. = 1 c. u.) shows an activity ranging from 53 mgm. to 100 mgm. per c. u.

*This opportunity is taken to express thanks to Doctors Knudson & Dresbach for their very kind co-operation.

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PHARMACY; PAST, PRESENT AND FUTURE*

Joseph W. Jacobs, Ph. M., D. Sc.

THE KEYNOTE of this meeting of our association in this hospitable old Georgia city of Macon, it seems to me, should be pride in the glorious past in pharmacy and thrilling hope for its future.

If age and the traditions of longevity and an unbroken usefulness are needed to justify the claim for worth and dignity in any profession, surely ours can meet every phase of these requirements. The story of its origin begins with the earliest annals of social growth, and is found in the language of every nation. It adorns the pages of classic literature. The cuniform inscriptions of the Assyrians contain its symbols, the histories of ancient Egypt and China are full of references to its processes and accomplishments. Had pharmacy not been regarded as one of the most important of the professions of men, it could not have inspired such writers as Pliny to devote nearly half of his voluminous works to an enumeration of thousands of items dealt in by its votaries, nor could it have called forth the best talents of such commentators as Dioscorides, Galen, Myrepsus and scores of other similarly gifted historians.

And if recognition by law, which is proof of general interest, is an index that points to the values of a calling, we may reflect that our profession was regarded in the systems of every jurisprudence in the earliest days of society. To go no further back than the endings of the "dark ages," we know that the Arabians in their legislation clearly drew the distinction between medicine and pharmacy in the eighth century. In Germany, in 1236, Emperor Frederick II had

*Presented at the 1926 Meeting of the Georgia Pharmaceutical Association, at Macon, Ga.

laws enacted for its regulation—and England, under Edward III granted a pension to Courses de Gangland as an apothecary.

Today, every civilized state regulates the practice of pharmacy by law and prescribes the rights and duties of its practitioners, so that pharmaceutical law may now be ranked as a distinct branch of jurisprudence.

A profession, it may be added, also presents a source of pride to its votaries in the volume and character of its literature. In this respect we may not be ashamed to have a comparison made with any other branch of learning. The libraries of the world are enriched by its lore, presented in every language that is printed, and in form that for learning, matter and style will satisfy the most critical as to value. The literature of pharmacy, again, is imbedded throughout the books on every physical science—in chemistry, in botany, in philosophy, and even in all religions. Can we not feel a pride to know that the Army Medical Library of our own great country contains 4000 volumes devoted to pharmacy and that the fifty years collective index of the American Pharmaceutical Association contains over 55,000 titles and 700,000 references covering the pharmaceutical literature of the world?

It might be expected that France should publish the first scientific journal devoted to pharmacy and we find this to be done in the Observations de Medicinia, Chirurgie de Pharmacie in 1797, but America leads in having issued the first periodical on pharmacy in the English language in establishing the AMERICAN JOURNAL OF PHARMACY in 1826 in Philadelphia, and which has continuously held the unique position of being exclusively devoted to our interests.

And how shall we estimate the worth of our great American Pharmaceutical Association with its wonderful accomplishments and contributions to the welfare of mankind? No association has loftier aims nor more fully lives up to their requirements. The volumes of its proceedings would repay the attention of any searcher in the fields of science, and contain in themselves a wealth of pharmaceutical learning that reflects glory on America.

Truly should we feel a pride that our Georgia Society forms a part of such an organization?

But what of the future of pharmacy?

Can we not foresee, with such a rich inheritance, that still greater triumphs in the domain of our science still await their unfolding? And no less may we work in the certainty that as a busi-

ness, still greater rewards are in store for those who know its possibilities and give their earnest labors in its vocation.

Never in all the history of the world was there more vibrant business era than ours, nor one in which facilities and materials for expansion and success were more abundant.

All the forms of transportation, by land, by water and by air invite a profitable using. Communication by telephone, by telegraph, by mail, by radio has expanded and multiplied the powers of business in ways no less than miraculous, and all are at our disposal in aiding us to collect the materials of trade and distribute them, to our profit, to the widest areas in the shortest time. The processes of manufacture, as applied to all industry have so improved that all business is now furnished with goods to buy, and sell in quality and quantity never before in the power of the merchant. The growth of public health efforts with the addition of the results of universal education has caused a demand almost unlimited for all the articles kept in our stocks that relate to personal hygiene, and the list of articles of the drug kind that have become almost daily necessaries are practically not to be numbered. These are being more and more demanded by an educated population, ever increasing, which is constantly growing in its buying power.

The vast funds that have been founded by philanthropists for general benevolence, are affording the means for research in our pharmaceutical laboratories and new remedies are being constantly found that require manufacture and demand the skilled pharmacist for their proper distribution. And these foundations are enabling learned societies to send out searchers into new regions of the world to explore and find new sources from which we may obtain our medical supplies. Their discoveries must be noted and brought under the domain of our business.

Can we not hope that those of us who have during all our business lives given our thought and labors to pharmacy may take new heart to go forward to greater achievements and success?

To the ever-increasing number of young graduates of our colleges of pharmacy, who now number between three and five thousand a year, may we not hopefully look for a continuation of the growth of the business? Many of these will enter business. Those who may be fortunate to possess the means for opening their stores at once, should know that only by care and work and continued study of their profession can they succeed. The mere possession

of capital is not enough. Vigilance, persistence, patience and well directed work is the price of any business success, and money that comes to us not earned, may often be the cause of failure. The motto of Thomas Carlyle: "Know thy work, and go at it like a Hercules," may well be their guiding admonition.

Many will be compelled to serve an apprenticeship and labor to earn the means by which they may enter business. During this period the process of saving will be their hardest task. This involves sacrifice of pleasure, often the necessaries to curtail, for the first five hundred dollars of our saving is the hardest part of the job. Yet the lessons learned in this accomplishment will be of untold value in leading them upward toward their object of ambition. The annals of business are full of examples of those who attained the loftiest mountain tops of success starting from the lowliest vales of obscurity.

Let us all, therefore, "carry on" with good heart and willing hands to bear forward the work of our calling, knowing that our business is "as vital to the health and happiness of our national life as food and drink and will survive and develop as long as the human race endures."

DETERIORATION OF STRONG SODIUM HYPOCHLORITE SOLUTIONS*

By Ralph Lloyd Wells

STRONG solutions of NaOCl are very desirable commercially due to the great saving effected by the decrease in bulk, but the saving is more than offset by the loss due to the deterioration of such strong solutions.

At the present time about the strongest solution on the market is Chloros, a solution of NaOCl containing approximately 10 per cent. available chlorine. Even in such a solution, however, the deterioration is rather rapid until a much weaker solution is obtained, and yet a solution of NaOCl containing 10 per cent. of available chlorine is a comparatively weak one, as it is possible to prepare solutions containing 42 per cent. available chlorine.

*An abstract of a thesis submitted to the Faculty of the Philadelphia College of Pharmacy and Science in partial fulfillment of the requirements for the degree of Bachelor of Science.

Experiments were conducted to determine the rate of deterioration of moderately strong solutions of NaOCl and, if possible, what substances could be used to decrease the rate of deterioration.

As it is definitely established that solutions of NaOCl, excepting very weak ones, will not keep at all if there is not an excess of alkali, all the solutions used were of this type.

The deterioration of three commercial solutions of NaOCl was observed for a period of three months, analyses being made approximately every two weeks to determine the per cent. of available chlorine.

Solution	*A*	*B*	*C*
Sp. Gr.	1.167	1.261	1.247
% Av. Cl	8.42	13.28	11.32
% Cl in NaClO	4.21	6.64	5.66
% Cl in $NaClO_3$	0.104	0.040	0.044
% Cl in NaCl	3.70	6.93	6.12
% Total Cl	8.01	13.61	11.82
% NaOH	1.51	0.42	2.68
% Na_2CO_3	2.87	1.42	2.17

PER CENT. OF AVAILABLE CHLORINE.

Date	*Sol. A*	*Sol. B*	*Sol. C*
1-30-26	8.42	13.28	11.32
2-11-26	8.02	11.25	10.24
2-26-26	7.48	9.39	8.42
3-9-26	7.00	8.26	8.11
3-27-26	6.95	7.89	7.68
4-15-26	6.50	6.82	6.92
5-5-26	6.07	5.95	6.34

From the analyses it appears that the greater the concentration of NaOCl the greater is the rate of deterioration until a certain point is reached.

Various substances were added to one of the solutions in amounts approximately to 0.1 per cent. of the solution to determine their effect upon the rate of deterioration. Solution B was the one used as it contained the greatest amount of NaOCl. The substances used were:

Ferric Chloride	Hydrogen Peroxide	Copper Foil
Ammonium Chloride	Paraffine Covering	Copper Wire
Ammonium Carbonate	Ethyl Alcohol	Iodine
Boric Acid	Aniline	Zinc
Citric Acid	Tin	Lead Acetate
Sodium Acetate	Aluminum	Silver Nitrate
	Cumar	

Cumar is an artificial resin sometimes used as a protective covering for tanks in which the NaOCl solutions are prepared.

None of the added materials retarded the rate of deterioration, but neither did they increase the rate of deterioration except in the case of Ethyl Alcohol, Aniline, Copper, and Aluminum.

In the solutions to which the Ethyl Alcohol and Aniline were added the NaOCl was decomposed practically immediately. Aluminum caused the solution to decrease from 8.26 per cent. to 4.44 per cent. available chlorine in one month and the Copper caused a decrease from 8.26 per cent. to 0.24 per cent. available chlorine in one month.

Two solutions of NaOCl were made to determine whether an excess of alkali as Na_2CO_3 would be better than an excess of alkali as a mixture of Na_2CO_3 and NaOH.

One solution contained as excess alkali 2.80 per cent. Na_2CO_3 and 2.12 per cent. NaOH; the other solution contained as excess alkali 5.98 per cent. Na_2CO_3 and no NaOH. The solutions were observed for two weeks, but no difference in their deterioration could be determined.

Although an excess of alkali is necessary to preserve a solution of NaOCl for even a short time, it does not seem to make any difference whether the alkalinity is due to a mixture of NaOH and Na_2CO_3 or to Na_2CO_3 alone.

ABSTRACTED AND REPRINTED ARTICLES

THE SCOPE OF ORGANIC CHEMISTRY*

Professor J. F. Thorpe, London, England

[An Abstract of the Presidential Address on "The Scope of Organic Chemistry," Which Professor J. F. Thorpe Delivered Before the Chemistry Section of the British Association at Oxford, on Thursday, August 5, 1926.]

THE CHEMISTRY of the compounds of carbon covers a wide field, wider than that covered by any other element. Its scope embraces all living matter, as well as the vast number of non-living substances which are produced through the agency of life. Moreover, it includes a very great number of compounds unrelated to life or to living processes which have been built up by the chemist in the laboratory by methods he has devised.

Already some 200,000 definite compounds have been tabulated in Richter's Lexicon and in the supplements thereto, and this number is increased yearly by several thousands through the agency of a band of zealous workers scattered over the globe. It may be well asked what is the good of continuing to increase this already astonishing number; and is the expenditure of time, labour and energy justified which lead to the discovery of some new fact having, apparently, no useful application to any department of human activity? The answers to these questions are quite clear and definite. You must acquire a knowledge of the simple before you can attack the complex with any hope of success. The element carbon has been used by nature as the basis of organised life because the capacity of carbon to combine with itself is shared by no other element, and it is upon this capacity that nature has relied in order to build up the tissues and reserve materials which form the living world around us. Until we can determine how a small number of carbon atoms combine one with the other we cannot hope to obtain any insight into the manner in which the more complex natural substances are built up, or any information regarding the way in which they are utilised to bring about the changes occurring during animal and vegetable metabolism.

*From the *Chemical Age*.

The science of structural organic chemistry is only just fifty years old. It was born when the genius of van 't Hoff gave to the world the clue upon which the three dimensional formula we now use is based. It is, therefore, no inconsiderable achievement to have gained in so short a time a knowledge of many of the reactions and properties of the more simple complexes of carbon in combination with oxygen, nitrogen, and other elements. But much yet remains to be done before we can attack with any real hope of success the problems which the chemistry of nature presents.

The Electronic Theory

It is clear that our knowledge of the finer mechanism of reactions is slight, and that great as has been the advance made through the discovery of van 't Hoff, we are still at a loss to explain or predict the shades which determine whether one particular type of reaction will be more, or less, facile than another. The chief trouble seems to be that the electronic theories, which are quite satisfactory in themselves, are not yet developed so fully that they can include any quantitative statement relating to the changes in the free energy of systems. Yet it is evident that any theory of organic structure must conform to the modern physical conceptions of matter. The principle of shared electrons is primarily justified by its success in explaining the linking of atoms, *i. e.*, valency, and by its successful interpretation of the theory of co-ordination and "onium" salt formation. The subsidiary hypothesis of electron displacement also provides a means by which an explanation can be supplied to account for the ease of formation, stability, and general reactions of conjugated systems, thus placing the hypothesis of Thiele on a sounder theoretical basis.

The ductility of the carbon to carbon bonds which have now been clearly demonstrated enables us to impart strains to certain parts of an organic molecule at will, and it is reasonable to assume that such strain when once set up will be shared as far as possible equally by all the atoms of the system involved. If this distribution is, as Robinson postulates, effected by a restricted flow of electrons from one atom to another in the molecule we have, at any rate, a definite picture of the process which the mind can grasp; and if the distribution leads ultimately—as is to be surmised—to the establish-

ment of polar characteristics at different parts of the molecule, which will determine reactivity at those points, we are in a fair way to reconcile the views of various contending schools and to reach a general hypothesis acceptable to all chemists, and which may even satisfy the physicists. It seems that, despite the organic chemist's proneness and ability to distort the molecules with which he deals, nature has provided a means by which a certain degree of molecular equilibrium can be attained. Nevertheless it will be by the investigation of the conditions leading to the setting up of strain and of the effect produced thereby that we shall gain the most information regarding the chemistry of carbon structures in the near future.

Strainless Systems

It is reasonable to assume that the organic substances that occur in nature as such are produced by means which involve the least expenditure of energy, and that they are, therefore, strainless. Among such natural products there are many containing carbon rings belonging to ring systems which cannot normally be produced without distorting the carbon tetrahedral angles of the component carbon atoms, and thus imparting intramolecular strain to the compounds formed. Nevertheless it is interesting to note the means adopted by nature to relieve this strain and thus to confer equilibrium and stability on quite unlikely ring systems. Ring systems stabilised in this way are found frequently among terpenes; two, namely camphor and pinene, need only be mentioned to illustrate the general method. In camphor the bridged ring is stabilised by the presence of two dimethyl groups, and in pinene, where the junction of the inner ring has to take effect in the position 3, the presence of a double bond on the shoulder of the external ring is necessary. Still more remarkable examples are afforded by more complex natural ring systems.

Biochemistry

In its earliest days the science of organic chemistry dealt only with those compounds which were derived from natural sources, and it was regarded as certain that such substances could only be produced through the agency of life and by no other means. Since then this theory has been shown to be wrong by the preparation in the labora-

tory of many substances identical with those formed during the operation of life processes. Nevertheless, the more complex substances which nature utilises in building up her animal and vegetable structures still show no signs of yielding the secrets of their constitutions, or the mechanism by which they are produced. Indeed, although we can imitate in the laboratory certain natural operations such as the hydrolysis of starch to glucose, we are still quite ignorant of the means by which glucose is converted, by the appropriate enzyme, into alcohol and carbon dioxide, neither can we imitate this process in the laboratory.

When once the chemist has passed beyond the crystalline and the distillable he enters a region full of difficulties, because he has few means either of purifying the materials with which he has to deal, or of determining their homogeneity when they have been purified. These are the real difficulties which confront the biochemist when he approaches his subject from the structural side of organic chemistry. Biochemistry is in the unique position of being both a descriptive or observational science as well as one of the experimental sciences. From the biological side it has at its disposal the wealth of knowledge acquired by the physiologists and pathologists, and from the chemical side it is in touch with the recorded experience of several generations of organic chemists. If biochemistry is to justify its name it must carry out its function of bringing into line the discoveries of the physiologists with organic chemical structure, for by this means only will it be possible to gain an insight into the chemistry of natural processes which it is the object of biochemistry to discover.

It is far from my object to disparage the wonderful work which has been done and is being done by physiologists and pathologists in their attack on the mechanism of normal and abnormal life processes. Their record speaks for itself. But too little is being done to approach the problems from the purely organic chemical side, and too few of the people engaged in biochemical research have an adequate knowledge of organic chemistry, or the methods of the organic chemist. The number of organic chemists who are co-operating with biologists in their attack on natural processes is too few. Indeed, the very difficult question arises here as to how best to organise methods for dealing with problems which are essential borderland problems between two great sciences. I do not propose on this occasion to discuss the vexed question of the chemical engineer, but actually the

analogy between this hybrid and the biochemist is fairly close. Is the biochemist to be a biologist with a knowledge of chemistry, or is he to be a chemist with a knowledge of biology? I refer, of course, to the method of training required for a man or woman who proposes to take up biochemical research during the fourth year. Given twenty years and the requisite capacity it is, of course, possible for a man to acquire sufficient acquaintance with both sciences to render him an effective worker in the borderland field, although here again the temperament which promotes enthusiasm for research in the experimental sciences and that which leads to initiative in the descriptive sciences is not usually found in the same individual. As knowledge increases the need for specialisation must also increase, because the time factor, that is the time during which it is possible for a student to undergo training, cannot be prolonged beyond a certain period.

Even at the present time it is an open question whether it is possible to give a student a special training in more than one science and in the sciences subsidiary thereto in the time available, and this problem will become more acute as knowledge increases. It has been suggested that we should revert to the older method by which a student was instructed in, say, three sciences without any special training in any one of them, and doubtless this method was a good one for the requirements of those times. But the day of the universalist is past, and general scientific culture has become a luxury of the leisured classes. It is only by the aid of the specialist that, nowadays, we can hope to obtain advances in knowledge either in the sciences or in the sciences applied to industry.

It seems that the best method to attack problems in the borderland subjects is by co-operation between the two types of trained investigators. We are far from gaining any insight into the meaning of life, but it is not unlikely that we shall, in the near future, obtain some information regarding the mechanism of the action of the enzyme, the important agent in the non-living transformation of living matter into chemical products. It may be that organic chemists are waiting to see how Willstätter, who has already made great progress in enzyme chemistry, will surmount the difficulties confronting him, and it may well be that this great organic chemist will introduce new methods of attack which will open up fresh fields for investigation.

Analytical

Except for the substitution of gas for charcoal, it cannot be said that the ordinary methods of analysis employed by the organic chemists have changed much since the days of Liebig. They have been modified, notably by Dennstedt, and more recently some have adopted the microchemical methods introduced by Pregl, but the older methods, for example, the long and tedious process for the estimation of halogens by the method of Carius, are still in vogue in many of our laboratories, and are taught to the students. In any case the usual operation entailed by the estimation of carbon and hydrogen, nitrogen, sulphur and the halogen require considerable time, which has not been materially shortened by the introduction of the less cumbersome methods due to Dennstedt. Pregl's methods, in which a very small quantity of material is used requiring the provision of a special type of balance, have been tried in many laboratories, and have found favour, it is understood, in several of them, more particularly abroad.

But the general experience has been that the technical skill required to obtain good results is acquired only after long practice, and that whereas the methods are useful for gaining an indication of structure when the quantities of material at hand are so small as to necessitate their use, yet when a sufficient quantity of substance is available the older methods are more reliable and more easily carried out. It is interesting to note that the new methods which have been introduced by Prof. ter Meulen, of Delft, are going to be described to us by Prof. ter Meulen himself, who is fortunately with us at this meeting. Prof. ter Meulen will give an account of his methods on Tuesday morning, and they will be shown in actual operation during the soirée on Tuesday evening. Chemists will then see that a great saving of time can be effected by methods which can not only be used to analyse the small quantities employed by Pregl, but also quantities of 0.1 grm., such as organic chemists have been accustomed to use in the past, and which have been shown to produce the most accurate results.

The Utilisation of Forest Products

The immense number of organic compounds distributed among the plants, trees and grasses which form the forests and jungles of the world, offer a wide field for research which has still much to yield. Our knowledge of the medicinal properties of organic sub-

stances and the various uses to which they could be put in the service of mankind did not come to us through any effort of the chemist, but as the outcome of a process of trial and error which is as old as the human race itself. These products were obtained from vegetable materials present in the forests, and as time went on they were extracted in a form possessing some degree of purity, and the plants containing those with specially valuable properties were cultivated for their production. As soon as a theory of organic structure was evolved upon which prediction could be based, these useful products were subjected to close investigation, and in several cases they were prepared by laboratory means. As an outcome several of them, such as indigo and alizarine, were found to be capable of production more economically by the chemical method than by the processes of life, and the natural substances were rapidly replaced by the artificial products. Others still resist all efforts to unravel their structures, and remain still unsynthesised.

Nevertheless it has been by a study of the chemical structure of natural products that much has been learnt regarding the relation between chemical composition and physiological action, and although it may not have been found possible economically to prepare the natural substance itself, the clue revealed by the determination of structure has led to the production of other substances which have not only shown the properties of the natural compound in an enhanced form, but have also exhibited other valuable physiological effects. The determination of structure has, therefore, two objects—to prepare the natural substance and to ascertain the particular arrangement of the atoms in the molecule which confers on it the properties which determine its value. The determination of the structure of indigo led not only to the production of the blue natural indigo, but enabled indigoes of every shade of the spectrum to be prepared as commercial products. The determination of the structure of cocaine revealed the molecular complex which conferred on this substance its power to act as a local anæsthetic, and has led to the production of a number of other substances possessing this valuable property, but without the special disadvantages attaching to the use of the natural substance. Examples of this kind are numerous and should be increased. A systematic examination of our forest products would undoubtedly lead to the discovery of many others, and would provide opportunity for the investigation of many other important prob-

lems, such as, for example, the utilisation of forest grasses as a source of power alcohol.

Systematic team-work by research organic chemists in close association with botanists is required, and now that the Forest Production Research Board of the Department of Scientific and Industrial Research is in active operation, no doubt this branch of its work will receive attention.

Petroleum

The complex hydrocarbons which form the main constituents of crude petroleum belong to a section of organic chemistry at present too little explored. Although many millions have been made through the production and sale of petroleum products, it is safe to say that the percentage of profit devoted to research in oil products has been infinitesimal. It is true that in the United States large sums are given by the oil interests towards research in other subjects, but until quite recently none of these was, curiously enough, given for the purpose of improving our knowledge of the science on which the utilisation and isolation of petroleum products depends. The reason is not far to seek. The apparently inexhaustible supplies of petroleum render it unnecessary to devise means for economical working. The crudest and most wastful methods were employed, because economy and the conservation of the natural product were not paying propositions. This applies not only to the methods used in fractionation, but to those employed for the purpose of "cracking" the higher boiling fractions into liquids of lower boiling point. For at the present moment it is the fraction up to 200 degrees C. which is the important product, because it is the "petrol" of the internal combustion engine.

Time was, before the introduction of this particular machine, when the light fraction from crude petroleum was a drug on the market, and in many cases was actually set on fire at the refinery because no use could be found for it. In those days the chief product was the kerosene fraction which was used as lamp oil. At the present time the rapid increase in the use of the motor car for personal and commercial transport indicates that at no distant period, if progress continues to be made in the same direction, the amount of the "petrol" fraction will be insufficient for the world's needs. This point has

already been reached in America, where approximately 70 per cent. of the world's consumption of petrol (gasoline) is effected. During 1925 the consumption of petrol in the U. S. A. approached 800,000,000 gallons a month, which is about twelve times the amount consumed in this country. It has been stated that one in every five persons in the States—men, women and children—possess a motor car, and, be this as it may, it is evident that to meet such a colossal consumption means have to be found to utilise the higher boiling fractions, and indeed even the residues from the distillation processes.

"Cracking"

This "cracking" operation is now carried out on an enormous scale by numerous processes, all subject to patents, but differing from one another but slightly on the question of principle. All depend on the well-established fact that hydrocarbons of high molecular weight will break down into those of lower molecular weight if they are subjected to the requisite degree of temperature. Pressure appears to play an important part in the character of the product, as does also the surface action of the container or material used in the container to promote surface action. All are wasteful, because little or no research has been carried out on the true chemical nature of the cracking operation. Much permanent gas is always produced, consisting for the most part of ethylene and propylene. In the States the ethylene is allowed to go free, because its obvious utilisation in the form of ethyl alcohol is attended with difficulties, but the propylene is usually absorbed in sulphuric acid, and thus converted into *iso*propyl alcohol, useful as a solvent.

The production of these two unsaturated hydrocarbons provides a clue to the mechanism of the cracking process which is of some signifiance. If you break a long chain-saturated hydrocarbon one of your products must be an unsaturated hydrocarbon, and it is evident that cracked spirit contains a considerable proportion of such unsaturated bodies. Moreover, the cracking processes at present in use do not produce aromatic hydrocarbons, and it is on the presence of a proportion of these aromatic hydrocarbons that certain special properties of petrol depend. For example, the tendency at the present time is to produce for motor cars internal combustion engines of increased compression ratio, in order mainly to diminish the petrol consumption and thus increase mileage per gallon consumed. For

some reason, which research has not yet ascertained, the use of petrol which does not contain the right quantity of aromatic hydrocarbons of the benzene type leads to "detonation," "knocking," or "pinking" when ignited in cylinders giving more than a small compression ratio. This detriment diminishes the value of cracked spirit as such for any but low-compression engines, and many have been the devices suggested in order to overcome this difficulty.

A vast number of substances, selected more or less at random, have been tried as "anti-knock" materials, and as an outcome it has been found that one, namely lead tetraethyl, possesses the property, when present in exceedingly small quantities, of preventing the "detonation" of the explosion mixture in the cylinder. For a time lead tetraethyl (ethyl gas) fell under a ban in the States owing to a fatal accident which attended the spilling of a certain amount in one of the American factories, but it is understood that further investigation has led to a revision of the view first formed, and that considerable quantities of "ethyl gas" are now being used. The writer remembers visiting Wilmington in 1924, when some 500 gallons of lead tetraethyl were being made daily. Although there was naturally a strong smell of the material in the factory building, and he remained for some hours there, no ill-effects were noticed. It is obvious that the conditions which produce "knocking" and the reason why certain substances are "anti-knock" compounds, and why the presence of aromatic hydrocarbons prevent the phenomenon, must be made the subject of systematic research.

The question is also one of national importance, because in the case of high-compression engines, such as those used in aeroplanes, it is essential that a petrol should be used containing a high percentage of aromatic hydrocarbons. In war time these aromatic compounds will be required for the manufacture of explosives, and it is quite certain that there will not be enough for both purposes.

Nevertheless, it must be remembered that it is only at the moment that the low boiling fraction of petroleum is the chief marketable product. It is probable that progress in the future will tend more and more to produce a motor-car engine of the Diesel type, or one having a carburettor capable of effectively vaporising the higher fractions of petroleum. In these circumstances it may well be that the low fraction will become the less important part of crude petroleum, and that, instead of having to resort to "cracking," a process of synthesis, by which the lower hydrocarbons can be con-

verted into higher ones, will have to be adopted. As a matter of fact, there are methods known by which this can be effected. Pure *iso*amylene can, for example, be converted into diamylene by interaction with stannic or aluminium chloride, and the process can be carried further, so that perfectly good lubricating oils can now be made by the polymerisation of the lower unsaturated hydrocarbons.

Polymerisation and Depolymerisation

Polymerisation and depolymerisation are, therefore, the two operations which the petroleum industry must investigate and establish on a firm scientific basis by research, so that it may be in a position to supply the public need for any particular form of engine which the engineer may evolve. Especially is it desirable to ascertain under what conditions polymerisation leads to the formation of aromatic and naphthenic hydrocarbons. Considerable attention has been drawn within recent times to what may be termed in general the Bergius processes for depolymerising organic substances. The operation, which consists in heating the material under high pressure in the presence of hydrogen, was introduced in the first instance for the treatment of coal. There can be no question that great and fundamental changes are brought about in organic substances by the treatment whether a catalyst is present or not, and that a wide field for research is opened up thereby, but it is doubtful if, at the moment, general operations of this type can be regarded as commercial propositions. The plant is exceedingly costly and the conditions subject to wide variations which are difficult to control. Actually it has been ascertained that in the "cracking" of the kerosene fraction of petroleum hydrogen is unnecessary, and can be replaced by nitrogen without affecting the character of the final product.

Little is known of the constituents of crude petroleum, or indeed of the fractions into which it can be separated after purification and distillation. Some of the simpler hydrocarbons of the pentane and hexane type have been isolated and the presence of cyclic compounds has been established. Many of them are classed under the head of "naphthenes," but these are of uncertain structure. No doubt many are present in the crude oil, but it is certain that others are formed during the distillation process. It is clear that much opportunity for research work offers itself here, and it is probable that small alterations in the method of distillation may cause deep-seated changes in

the character of the distillate, causing it to be of greater service for particular purposes. The occurrence of hydrocarbons of the naphthalene series in petroleum products has also been clearly established. The higher fractions which constitute the valuable lubricating oils also need attention, for it is now certain that viscosity bears no relation to oiliness, that is, the capacity for acting as an efficient lubricator. The addition of small quantities of "polar" substances of the type of fatty oils or acids confers increased oiliness on these compounds, and although we are now gradually reaching a stage when we know more about the effect of such ingredients, the field for research is still a large and important one.

At present we know nothing about the structure of the hydrocarbons present in the lubricating oils. Indeed, it seems possible that these may not be long-chain hydrocarbons with which the organic chemist is familiar, but rather polymerised products formed from unsaturated components liable to be formed or destroyed under comparatively mild conditions. The relative ease with which the oil in the engine sump of a motor-car loses its oiliness through continued use is not characteristic of the stability usually associated with an organic hydrocarbon.

It is clear that the need for systematic research into the character of petroleum products is urgent, and it is gratifying to note that the Anglo-Persian Oil Company has established a research laboratory at Sunbury-on-Thames, in which the important principles underlying the industry have been and will be studied.

Dyestuffs and Intermediates

Prior to the war Germany manufactured three-fourths of the dyestuffs required for the world's markets. Of the remaining one-fourth, one-half was made from German intermediates and was, therefore, dependent on Germany. Switzerland, although without a domestic source of raw materials, ranked second with about 7 per cent. of the world's production. Great Britain produced about one-tenth of her requirements, and France produced in French-owned and operated plants from 10 to 15 per cent. of her consumption. In order to meet the patent requirements of France and Great Britain, German manufacturers operated plants in those countries where the final assembling operations were completed. The small dye industry of the United States was almost entirely dependent upon German intermediates. At the present time Great Britain produces 80 per cent.

of the dyestuffs required for our own use, and we are, therefore, in a position to review the conditions which have led to this remarkable change and to consider the procedure necessary to strengthen it.

It cannot be said that any fundamental advance in the chemistry of the dyestuffs has been made since Bohn discovered indanthrene in 1901, although great advances have been made since then in the preparation of new colours belonging to this and other known series. Consequently the research work necessary in order to establish our position as a dye-making country has been mainly along known lines, involving the extension of reactions which had already been established rather than the discovery of new ones. Nevertheless it is no inconsiderable achievement for our research chemists to have established a position such as that indicated above in so short a space of time, for many of the preparations, the details of which could only be found in the patent literature, had to be worked out *de novo* and the correct conditions found for their adaptation to the technical scale. It is probably along the lines of decreased cost of production that research work in the immediate future will be mostly engaged, and especially is this the case with the intermediate products from which the dyestuffs are derived. Moreover, the intermediate products are of the greatest importance for other industries, for example, the fine chemical industry, the perfumery, and the explosives industries, and any improvement in the processes for their manufacture or the production of new compounds having enhanced value from the commercial point of view is of the greatest importance to all these industries alike.

The parent substances of the intermediate products are the hydrocarbons of coal-tar or the coke oven by-products. The operations required to convert these hydrocarbons into the finished intermediates often involve many stages, any one of which depends for its cost on the purity and yield of the product. When large quantities are involved a difference of 1 per cent. in the yield may lead to a considerable difference in the cost of production, and it is obvious that reactions which yield their products in a state of purity sufficient for the market or further stage production without subsequent treatment make for reduced cost in production. There is thus a wide field for research into the improvement of technical methods which may well occupy the attention of our dyestuffs chemists for some time to come.

On the other hand, the question of fundamental research into new processes, both for the preparation of new intermediates and

new dyestuffs must not be lost sight of. The intermediate determines the character of the dyestuff, and it is always possible that a new intermediate may be discovered which will yield a dyestuff with just that difference of shade as to catch the public fancy, and which will lead to the replacement of the older dyestuff on the market. The sulphonic acids of the naphthol, naphthylamines and amino-naphthols are cases in point. These substances are used extensively for the preparation of azo dyes. There are a great number of these compounds theoretically possible, but only a few have found technical application owing mainly to the high cost of producing the others. The high cost is nearly always caused by poverty of yield, an objection which may be at any time removed by the discovery of an improved process.

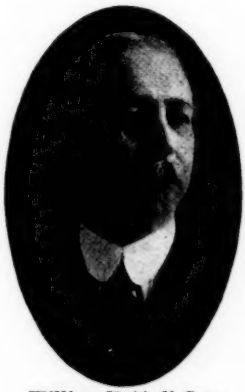
It is futile to say that the vast field of organic chemistry has been thoroughly explored for the production of new types. At any moment one or other of the men or women engaged in fundamental research may repeat Bohn's discovery of 1901, and obtain a new compound which will be the forerunner of a new series of dyestuffs. It is perhaps too much to ask an industry which is struggling to hold its own to expend large sums on the prosecution of abstract research, most of which will be of no use to it, but it is not too much to expect that the industry will take every means to foster and encourage abstract research in our university institutions, and even to give some lead as to the direction in which its experience leads it to think that advances may be made.

This aspect is of all the more importance at the present time, when organic chemistry is entering on a new phase which will undoubtedly revolutionise many of the existing processes of manufacture. It is now recognised that the presence of a small quantity of a catalyst may either alter the course of a reaction or may lead it to proceed to completion where otherwise a totally inadequate yield would be obtained. The catalyst may either be added or the containing walls of the reaction vessel may act in this capacity. The well-known example of the oxidation of naphthalene to phthalic anhydride by vanadium pentoxide is an example of this, but similar cases are continually recurring, and it has only recently been found that the classical method for preparing ketones by the distillation of the calcium salt of the appropriate acid can be utilised in the most unexpected directions if the thorium salt instead of the calcium salt is employed.

OBITUARY

WILLIAM H. GANO

WILLIAM HUBBELL GANO, treasurer of the Alumni Association of the Philadelphia College of Pharmacy and Science, died at his home, 3345 North Seventeenth Street, Philadelphia, on July 21, 1926, after an illness of ten weeks. Mr. Gano was a direct descendant of John Bartram, the first American botanist, and of the Rev. John Gano, who served as chaplain in Washington's army. He was born in Wilmington, Del., in 1862, the son of Charles H. Gano and Anna E. Bartram Gano. He was graduated from the Philadelphia College of Pharmacy and Science in 1884. The subject of his thesis was "The Scaled Salts of Iron."



William Hubbell Gano

After graduation, he clerked, successively, with George I. McKelvey, Joseph P. Remington and George B. Evans, of Philadelphia.

In 1892 he purchased the store of William H. Lantz at Seventeenth and Columbia Avenue, Philadelphia, and conducted a most successful pharmacy until he retired in 1914, after which he became a director of the Girard Avenue Title and Trust Company. He was one of the incorporators of the Philadelphia Wholesale Drug Company. He was a member of the Pennsylvania Pharmaceutical Association (1899-1926) and of the American Pharmaceutical Association (1892-1926). He was elected second vice-president of the Alumni Association of the Philadelphia College of Pharmacy and Science, in 1916-17, first vice-president in 1917-18, and treasurer since 1920.

The following resolutions were passed by the Executive Board of the Alumni Association on July 22, 1926:

> "The members of the Executive Board of the Alumni Association of the Philadelphia College of Pharmacy and Science note with sorrow the passing of William Hubbell Gano on July 21, 1926, and extend to his widow and sister their deepest sympathy.
>
> "Since his graduation from the College in 1884, Mr. Gano has taken the deepest interest in the Alumni Association and its work, having been second vice-president in 1916-17, first vice-

president in 1917-18, and treasurer since 1920. It was due, most largely, to his splendid initiative and personal work that the Sustaining Fund of the Association has been made possible.

"We wish to bear testimony to his work and worth. He was a man of the highest character, diligent in business, faithful in the performance of duties and kindly in all his relations with his fellow men. We shall miss him, but the memory of his gracious and lovable personality will remain with us.

"By resolution of the Board of Directors at a special meeting held July 22, 1926, the above appreciation was directed to be entered on the minutes and a copy sent to his widow, Mrs. Lydia E. Gano, and his sister, Mrs. Emil Larsson."

He is survived by his widow, Mrs. Lydia E. Gano, and a sister, Mrs. Emil Larsson, of Plainfield, N. J.

Funeral services were held at his late residence on July 24, 1926, at 2 P. M.; interment at West Laurel Hill Cemetery. The services were under the direction of the Rev. Robert Littell, of the Tioga Presbyterian Church.

NOTES FROM THE INTERNATIONAL CONGRESS OF PLANT SCIENCES*

Ithaca, N. Y.

MANY PLANT SPECIES EVOLVE FROM HYBRIDS—Evolution among plants is due at least partly to spontaneous crossings or hybridizations in nature, according to Professor E. C. Jeffrey of Harvard University.

Many of the plant groups that contain the largest number of species have reached their wide development in this way, the Harvard scientist declared. Notable examples are to be found among such familiar wild genera as blackberries, wild roses, wild asters and goldenrods. Less familiar but equally valid cases have been discovered among some of the obscure plants related to ferns. And lately the southern hemisphere has contributed further evidence from among the hundreds of species in such genera as eucalyptus and acacia, to which attention has been called by Dr. Leonard Cockayne, a well-known New Zealand botanist.

Prof. Jeffrey stated that efforts are now being made at Harvard to unravel the hybrid ancestry of certain plants which have long been

*Through *Science Service*.

listed as perfectly solid species, and that the results may throw further light on some of the difficult questions of plant evolution.

SERUM TESTS DEMONSTRATE RELATIONSHIPS OF PLANTS—The relationships that all plants bear to each other as branches of the great evolutionary family tree have been demonstrated by means of serum chemistry, the same method that has been used in criminology to indicate whether or not a dark stain was made by human blood, and in medicine to determine whether in a given case a blood transfusion might be safely made. A report on researches on the "blood relationships" of plants was made to the International Congress of Plant Sciences, by Prof. Karl Mez and Dr. H. Ziegenspeck, of the University of Koenigsberg, Germany.

The German scientists asserted that their investigations had confirmed the opinion held by many botanists that the lowest of all forms of life are the bacteria; that the lower fungi, however, were not derived from the bacteria, but from certain of the lower water plants. Higher in the scale, they found that the most primitive of all the plants with bright flowers are the magnolia trees and similar plants. From these arose in one direction the plants of the lily, palm and grass families, and in others the kindred of the roses and the inconspicuously-flowered pigweeds and lambs-quarters.

COMMON GARDEN FLOWERS HAVE ANCIENT LINEAGE—When did the ancestors of asters and zinnias and other bright flowers of our gardens first appear on the earth? They are among the oldest of flowering plants, and much more ancient than we have heretofore imagined, was the answer given before the International Congress of Plant Sciences, by Dr. G. R. Wieland, associate of the Carnegie Institution of Washington and lecturer at Yale University.

It has always been assumed that the trees related to our pines and others belonging to the kin of the tropical cycads were older in their origin than the bright-petaled flowers, Dr. Wieland told his hearers. Trees of this kind were common far back in the Age of Coal, and indeed make up a large bulk of most coals. But there are increasing evidences that in the Permian Age, immediately following the Age of Coal, and perhaps in the coal age itself, there were plants with small, delicately formed flowers and tiny seeds that were the forerunners of the common flowers and weeds of today.

Dr. Wieland pointed out that after the lapse of millions of years the pine-like trees would have a better chance of surviving as fossils, since their cones are relatively big and tough, whereas the delicate petals of soft fruits of the bright-flowered plants would have been more likely to be destroyed by withering immediately after they fell, or through the mischances of geological changes since.

By the time the dinosaurs arrived on the scene, millions of years after the coal was formed but other millions before man appeared, Dr. Wieland states, the vegetation of the earth was quite "modern" in aspect. But it is unlikely that a dinosaur could have appreciated a rose.

UNDERWATER SOIL AFFECTS GROWTH OF WATER PLANTS—Plants that grow in the water have their own soil preferences quite as marked as those of plants that grow on the land, though because we rarely see the bottom of a lake or pond we seldom think of this matter, Dr. W. H. Pearsall, of the University of Leeds, England, told members of the International Congress of Plant Sciences here. He has been investigating the water vegetation of English ponds, and finds apparently similar ponds with differing populations of water lilies, cattails, reeds, etc., have perfectly valid reasons for these differences, for under the surface there are considerable variations in the depth to which the bottoms are silted, in the fineness of the bottom soil, and even in the chemical nature of the water.

INCIPIENT EVOLUTION SEEN IN FREAK BACTERIAL GROWTHS—Evolution in its beginning stages may be the thing we see under the microscope when we look at a slide of bacteria that have been growing so long in one tube that they have begun to get soured on existence and are changing their shapes. Dr. Ralph R. Mellon of Rochester, N. Y., has made a study of these minute disease-carriers, and he thinks that when they change their shapes from rod-like to spherical, or begin to put forth branches as properly behaved germs should not do, they are not necessarily old or sick bacteria, which has long been the common opinion. They may be that, or they may be evolving into other kinds of bacteria, he told his fellow-bacteriologists in the International Congress of Plant Sciences at their recent session. He has taken specimens of these freakish, supposedly old or sick bacteria, and used them as the starting-points of new cultures, and he found that these new cultures behaved like entirely new brands

of bacteria; for example, some of them, from virulent disease-causing strains, had become much less malicious in their action. And he thinks it quite as possible for a hitherto mild and harmless breed of "bugs" to go through a change in the opposite direction, and become dangerous parasites.

SEX DIFFERENCE IN PLANTS FOLLOWS MICROSCOPIC DETAIL—A new link binding plants and animals together in a single web of living beings was the subject of Dr. Kathleen B. Blackburn of Armstrong College, England, in an address recently before the section on cell study of the International Congress of Plant Sciences. Dr. Blackburn has discovered that plants as well as animals have in their cells the special bits of living matter known as the sex chromosomes. Until her discovery only animals were known to possess this detail of their organization, but now she has demonstrated its presence in the cells of a number of plants which bear their male and female flowers upon separate individuals.

MICROSCOPE AIDS PETAL COUNTING IN TELLING DIFFERENCES AMONG PLANTS—The old picture of a systematic botanist, determining likenesses and differences among plants by counting petals, examining stamens, and so on, must now be modified to include a high-power microscope, according to Prof. Otto Heilborn of Stockholm. Plants that differ in species differ also in the numbers of their chromosomes, the exceedingly tiny bits of living substance within the cell that turn especially dark when a plant section is prepared for the microscope. Examination of these minute details, Prof. Heilborn told his hearers, frequently settles vexed questions of identity, especially in the cases of important economic plants whose ancestry has in many instances become much mixed and hard to determine.

WATCHES DEATH-THROES OF CELL ATTACKED BY PARASITIC FUNGUS—The death-throes of a single plant cell, a microscopic tragedy that is repeated by the billions in every grain field or truck patch attacked by smut, rust, blight or any of the hundred other destructive plant diseases, was described by Prof. J. Beauverie of the University of Lyon.

When the feeler-like thread of the fatal fungus reaches the cell, some poison which it emanates throws the cell's living substance, the

protoplasm, into a state described as "hypertonic"—roughly analogous to fever. Death soon ensues, and the breakup of the cell content follows. First, the protoplasm becomes finely granular; then, when water enters, certain special denser bits of it swell up into tiny bubbles and burst. The minute green bodies that give the plant its color become granulated and run together, giving off droplets of oil. In the end, the fungal thread is left in full possession.

In addition to certain technical considerations, Prof. Beauverie pointed out that the solution of this microscopic problem is the basis for attack upon the great economic problems presented by plant diseases, which cost the world millions yearly.

Every Little Bacillus Has a Figure All Its Own—The germs that plague us with diseases look as different to the skilled eye of an experienced observer as do the men and women they afflict, stated Dr. Hilding Bergstrand of Stockholm. We have been in the habit of assuming that the outward appearance of these very tiny parasites is always the same, he said, and this easy assumption may get us into trouble if we mistake a harmful variety for a harmless one whose disguise it may for the moment have assumed.

Starting with a single isolated bacterial cell, Dr. Bergstrand stated, it has been possible to cultivate a progeny that differ among themselves in appearance more than do the human inhabitants of a city. The looks of bacteria can be markedly affected by the kind of food they have had to eat; so that he warned his hearers not to identify germs by their outward form without taking into account the culture media in which they had been raised.

SCIENTIFIC AND TECHNICAL ABSTRACTS

New Elements.—As is generally known to chemists, Moseley in 1913 made the important and valuable discovery of the relations of the atomic numbers from which has been obtained a guide to the suggestion of new elements superior even to the familiar periodic system. By his death in the British service in the Dardanelles in 1915 science lost a very valuable worker. The atomic number is determined by the number of electrons in the atom round the nucleus or the number of free electrons in the neutral atom or the number of

free positive charges in the nucleus. Moseley thus corrected those instances in the periodic table in which it was known that the properties of certain pairs of elements demanded that their positions should be interchanged, an arrangement which could not be reconciled with their atomic weight. This summary of Moseley's work is given by N. M. Bligh, F. C. S., in *Science Progress* (1926, *20*, 109).

At the time Moseley published his work several numbers were unfilled: 43 and 75, analogues of manganese; 61, a rare earth element; 85, a halogen; 87, an alkali metal; and 91, just below uranium. Whether there are any elements above uranium, that is, above 92, cannot be positively stated. Some chemists incline to a limit at this point. Gaps have been filled since Moseley's death. Forty-three and 75 were discovered in June, 1925, by Noddack and Tacke in Berlin, termed respectively masurium and rhenium. These are names of territories affected by the Versailles treaty, and the affixing of their names to the new elements seems to have more than a sentimental significance. In March, 1926, B. S. Hopkins, of the University of Illinois, announced the discovery of an element with the atomic number 61, which has been called illinium. It lies in the group of rare earth elements and completes the group. According to Brigh's paper, interesting opportunities for discovery exist in connection with the missing 85, a halogen, and 87, affiliated with potassium.

In this connection it may be worth while recalling that shortly after the development of the spectroscope as an instrument of research Bunsen and Kairchhoff, of Heidelberg, discovered cæsium and rubidium by means of the instrument. Chemists were in those days somewhat astonished at the fact that to obtain a little over a hundred grains of the mixed chlorides of these two elements about twenty tons of water of one of the German springs were evaporated. The yield of radium from its richest ores is far less than this. H. L.

Solid Helium.—A note in *Nature* (1926, *118*, 58) gives the information that Professor Keesom, successor to H. Kamerlingh Onnes, University of Leiden, has succeeded in solidifying helium under a pressure of 150 atmospheres at its boiling point and under a pressure of 28 atmospheres at a temperature of 1.5° K. Solid helium is transparent. H. L.

Walnut Roots Contain Poison for Other Plants.—The roots of walnut and butternut trees are poisonous to other plants whose roots are so luckless as to come in contact with them, Prof.

A. B. Massey, of the Virginia Agricultural Experiment Station has discovered.

It is a matter of common observation among market gardeners that tomatoes and potatoes will not grow in the vicinity of walnut and butternut trees. In the shrubby cinquefoil area of Vermont, the refusal of this virile weed to grow near butternuts is very striking, while in southern Indiana the old settlers declare that newly cleared walnut land would not grow good crops for several seasons. In various parts of the country the death of certain weeds and even young apple trees in the vicinity of walnut and butternut has frequently been observed. In Indiana, the leading tomato state in the Union, the harmful effects of these two trees growing in fence-rows or in the fields, is frequently of economic importance to growers of tomatoes.

Prof. Massey has concluded that the poisonous property of the walnut root is due to a specific toxin, which he has called "juglone," from "Juglans," the scientific name of the walnut genus. The toxic substance, which is contained in the root bark, is not generally distributed in the soil, and the evidence indicates that injury to surrounding plants usually takes place after contact with the offending walnut roots.—*Science Service.*

Hybrids of Plant "Missing Link" Produced—Crosses between different species and genera of cycads, strange plants that have survived from days before the Age of Dinosaurs, have been made at the University of Chicago greenhouses by Prof. Charles J. Chamberlain. To get the first crop of seeds from his hybrids, Prof. Chamberlain will have to wait patiently for at least ten years. Then he can, perhaps, go on with his experiment with these "living fossils," survivors of an ancient forest where the plants stood intermediate between ferns and the higher seed plants of today. The account of the first successful steps in this long experiment appeared in the July issue of the *Botanical Gazette.*

Prof. Chamberlain gathered part of the material for his work in the jungles of Mexico, and part of it from South Africa, Porto Rico, Cuba and Florida. Transferring the pollen from the male to the female cones was a critical task, and waiting for the seeds to germinate after planting was a matter of months. The character of the leaves of the new seedlings shows that the parent with larger leaves is usually dominant, but a fuller study will have to be deferred until the plants are sexually mature and ready to produce cones of their

own, and this will require at least a decade and possibly a quarter of a century. Cycads are plants of exceedingly deliberate growth, Prof. Chamberlain explains; a stock little palm-like tree five or six feet high may be the product of two or three centuries.

Though of unusual scientific interest, cycads have but little economic importance at present. A number of species are used for ballroom decorations and in the making of memorial wreaths, some of them are exploited by commercial starch factories and some are used as food, although, in this case, precautions must be taken on account of an alkaloid poison. However, cycads or their near relations that have been dead for many hundreds of thousands of years have great economic value now, because these plants played a considerable part in the formation of the great coalbeds.—*Science Service.*

Lifeless Chemicals Imitate Life Acts—Making lifeless chemicals act as though they were alive is the feat reported here by M. Herrera, a well-known French chemist. M. Herrera made a solution of fourteen parts of caustic soda and one part rhodamine in 100 parts of water, and poured a few drops of this into a second solution consisting of one part olive oil and two of gasoline. The drops staged a close imitation of the behavior of amœbæ, one of the simplest of animal forms. They divided, moved about slowly, elongated, formed vacuoles within themselves and constantly changed their shape. Under proper conditions they kept up this performance for as long as an hour. M. Herrera made no claim that the drops had any properties of life. The phenomenon, he said, is probably due to diffusion currents, changes in osmotic pressure, surface tension and other physical and chemical influences.—*Science Service.*

MEDICAL AND PHARMACEUTICAL NOTES

Partnerships of Germs May Cause Disease—A theory that may have an exceedingly important bearing on the cause of many obscure diseases has been advanced by Dr. Aldo Castellani, internationally known authority on tropical disease.

There is a condition among micro-organisms known as symbiosis, which in spite of its formidable sound simply means a close associa-

tion of two or more organisms in a kind of alliance like matrimony, with many of its benefits, but none of its drawbacks. Dr. Castellani believes that this state of symbiosis may be responsible for many symptoms and even the cause of some diseases not yet fully understood. "It seems certain," he says in a report to the American Medical Association, "that there are diseases caused by a true symbiosis or association of two organisms, neither of which alone is capable of producing the malady."

He cites, as an example, common itch, the eruptions of which are not due to the mite which causes it by burrowing under the skin, but to a pus-forming coccus that finds the skin irritated by the mite a particularly fertile field in which to increase and multiply. A similar condition maintains in the tropical malady, yaws, where the eruptions are likewise caused by an associated coccus and not the specific causative agent. Certain symptoms in severe cases of typhoid fever have been demonstrated, according to Dr. Castellani, to occur only in the presence of both the typhoid germ and another bacterium. Neither germ will produce the reaction alone, he says.—*Science Service.*

Government Warns Public Against Fraudulent Radioactive Waters and Drugs—The alleged medicinal efficacy of slightly radioactive waters and other slightly radioactive preparations has been found to be much misrepresented, say officials of the Bureau of Chemistry of the United States Department of Agriculture, who, in the enforcement of the Federal Food and Drugs Act, have made a nation-wide survey of waters and drugs alleged to be radioactive.

The products analyzed for content of radium included hair tonics, bath compounds, suppositories, tissue creams, tonic tablets, face powders, ointments, mouth washes, demulcents, opiates, ophthalmic solutions, healing pads and other preparations in solid, semi-solid and liquid form, for which therapeutic value because of alleged radioactivity was claimed. Only five per cent. of the products analyzed and claimed to be radioactive contained radium in sufficient quantities to render them entitled to consideration as therapeutic agents, and then only in certain very limited conditions, say the officials. Highly exaggerated therapeutic claims obviously designed to mislead the purchaser are being made for many of the products which contain little or no radium. One of the samples examined consist of a short glass rod coated on one end with a yellow substance and enclosed in a glass

bulb. The bulb is designed to be hung over the bed and according to the claims of the inventor causes dispersion of "all thoughts and worry about work and troubles and brings contentment, satisfaction and body comfort that soon results in peaceful, restful sleep."

Action will be taken under the Federal Food and Drugs Act against shipments of the alleged radioactive products which are falsely or fraudulently misbranded under the terms of the Federal Food and Drugs Act. A warning regarding the indiscriminate use of those few products which are highly radioactive is also sounded by the officials.

"The distribution to the general public without discrimination or adequate supervision of highly radioactive products or the devices for rendering water or other substances highly radioactive" says the department, "is of very questionable propriety since radium in active dosage is potent for harm as well as for good and should be administered with great caution."

ADRENAL GLAND SECRETION CAUSE OF BODY HEAT.—The mechanism by which the body keeps warm has received a new scientific explanation. Dr. Charles E. de M. Sajous, professor of endrocrinology at the University of Pennsylvania, thinks that suprarenin, the substance secreted by the adrenal glands, small organs just above the kidneys, plays an important part in the production of body heat.

Physicians and biologists have known vaguely for years that heat is released by some process of union of the body cells with the oxygen of the air through the action of the blood in the tissues, but just what chemical changes are involved has remained a mystery.

Dr. Sajous believes that suprarenin is carried to the lungs, where it takes up oxygen and is then absorbed by the red corpuscles of the blood and transported to the tissue cells. Here the complex chemical compounds that originate in the glands react with the partially digested food products to produce heat. This enables the enzymes or ferments present, which are very sensitive to heat, to complete the digestion of the food products, rendering them available for the work each tissue carries on.

This heat action must be so controlled, says Dr. Sajous, as to avoid excess heat, since any rise about 98.6 degrees Fahrenheit, the normal temperature of the body, means fever. Any excess is normally prevented by the glandular substance cholesterol, while adequate

production is assured by thyroxin, from the thyroid gland of the neck, which also acts as a stimulus to the gland product lecithin, the heat producer.

The beneficial effects of light and heat treatments, such as ultraviolet and Roentgen rays, are due to their speeding up of this physiological process, says Dr. Sajous. This heat energy, by increasing the activity of the enzymes present in the tissue cells, enables them to break down the disease-causing germs and the toxins they produce. Treatments with light and heat radiation are beneficial up to a certain limit, but care must be exercised that they do not increase the body temperature beyond this point, Dr. Sajous declares.—*Science Service.*

WHOOPING COUGH HELPED BY SIMPLE REMEDY.—That old reliable remedy, sodium bicarbonate, or baking soda, is now recommended in the treatment of whooping cough.

Recent work at the Kingston Avenue and the Kings County Hospital Laboratories, Brooklyn, N. Y., by Drs. J. C. Regan and Alexander Tolstouhov shows that this familiar bane of childhood is accompanied by a condition of severe acidosis which may be counteracted by small repeated dosages of simple alkaline salts, such as sodium bicarbonate, calcium carbonate or magnesium oxide. In patients treated by this method early or late in the disease, a cure is induced.

Blood examination shows that the inorganic phosphorous content during whooping cough is lowered and the hydrogen ion concentration is greatly increased. The alkaline doses bring about a rapid return of the phosphorus to its normal proportion in the content of the blood and counteract the acidity. These chemical changes in the blood are accompanied by pronounced improvement in the patients so that vomiting ceased, according to Dr. Regan, on an average within one week and whooping within two weeks, with occasional exceptions. The patients generally showed corresponding improvement and increase in weight. It has been suggested that the characteristic symptom of vomiting in whooping cough is a compensating mechanism of the body to eliminate the excess acid.

GENERAL ADMINISTRATION OF IODINE THOUGHT UNSAFE.—Is the consumption of iodized salt safe for the general public? According to such authority as Dr. Victor C. Vaughan, of the National Research Council, and Dr. C. L. Hartsock, of the Medical Division of the Cleveland Clinic, it is not.

Dr. Hartsock has reported to the American Medical Association that the continuous administration of iodine over a long period of time should never be prescribed for adults. There are many different sorts of thyroid disturbances, according to Dr. Hartsock, and even small amounts of iodine are likely to set up irritation in certain types that are exceedingly dangerous.

"Iodine administered in small quantities, periodically to children," he says, "under the age of puberty is a very efficient preventive of simple goitre. Community administration of iodine disregards physiologic facts regarding the effect of iodine on the thyroid gland. The use of iodized salt should be discontinued or limited absolutely to periodic table use by children under the age of puberty."

Dr. Vaughan maintains that the flood of iodized salt on the market is already doing harm.

"It should be understood," he says, "that there are different kinds of goitre and all kinds are not prevented, or, being present, are not benefited by medication with iodine. The wholesale use of medicine of any kind or chemicals of any kind by the people without medical supervision is fraught with danger."

NEWS ITEMS AND PERSONAL NOTES

Dean Charles H. LaWall was elected to a Fellowship in the Royal Society of Arts of Great Britain in April, 1926. He was also made a Fellow of the American Public Health Association in June, 1926.

Professor Cook and his family are happily settled for their European stay in Berne, Switzerland. Pharmacy and pharmaceutical education in America could not hope for worthier ambassadors, across the water, than this ideal American family group.

Despite the novelty of their environment there is a chord of real homesickness in every letter which they send back home.

NATIONAL CONFERENCE ON PHARMACEUTICAL RESEARCH INFORMATION.—The fifth annual meeting of the National Conference on Pharmaceutical Research will be held at Hotel Bellevue-Stratford, Philadelphia, Pa., on Saturday, September 11th, 1926.

There will be two sessions; one beginning at 9.30 A. M. and the other at 2 P. M.

The tentative program is as follows:

1. Roll Call.
2. Reports of Officers.
3. Reports of the Ten Standing Committees.
4. Report of Special Committee on Committees.
5. Report of Special Committee on Book of Research Achievements.
6. Reports from Delegates from the Affiliated Organizations, viz.:
   - (a) Association of Official Agricultural Chemists.
   - (b) American Chemical Society Division of Chemistry of Medicinal Products.
   - (c) American Conference on Pharmaceutical Faculties.
   - (d) American Drug Manufacturers' Association.
   - (e) American Pharmaceutical Association.
   - (f) American Pharmaceutical Manufacturers' Association.
   - (g) Bureau of Chemistry, U. S. Department of Agriculture.
   - (h) National Association of Boards of Pharmacy.
   - (i) National Association of Retail Druggists.
   - (j) National Formulary Revision Committee.
   - (k) Pharmaceutical Laboratory Seminar.
   - (l) Plant Science Seminar.
   - (m) Proprietary Association.
   - (n) U. S. P. Revision Committee.
7. General Discussion on:
   - (a) Census of Research.
   - (b) Gradute Students in Pharmacy and Their Research Work.
   - (c) Research Topics.
   - (d) Research Grants and Prizes.
   - (e) Research Fellowships and Scholarships.
8. New Business.
9. Election.
10. Adjournment.

A large attendance is confidently expected.

H. V. ARNY,
Chairman.

115 West Sixty-eighth Street,
New York, N. Y.